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New C- and O-isotopic compositions of smithsonite from Skorpion and Rosh Pinah Zn-(Pb) deposits (Namibia): preliminary results and implications

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The Skorpion and Rosh Pinah Zn-(Pb) deposits are hosted in Neoproterozoic rocks that are part of a volcano-sedimentary sequence within the Gariep Belt in southern Namibia. Genetically, the Gariep sequence is related to the progressive opening of a failed intracratonic rift graben in the east (Rosh Pinah/Skorpion Graben) that was separated by a basement horst from a half graben to the west, which then developed into the Adamastor ocean [1]. The deposits approximately 40 km north of the Orange river, are only at a 15 km distance from one another [1,2], however, Skorpion is located on an uplifted block whereas Rosh Pinah is located on a topographically lower block.

Skorpion is the largest Zn-nonsulfide mineralization ever discovered, and is derived from the oxidation of a VMS-type sulfide protore [1]. It mostly consists of Zn-oxidized minerals (sauconite, smithsonite, hemimorphite, tarbuttite, skorpionite). Rosh Pinah is a typical sediment-hosted Zn massive sulfide mineralization. The original oxidized interval at the surface was of limited extent and has been almost completely removed. Secondary minerals at Rosh Pinah are: smithsonite, hemimorphite, Cu-oxidized phases and Fe-oxy-hydroxides [2]. The isotopic composition of Skorpion smithsonite, already partly published by previous authors [1], shows that the supergene alteration of the sulfide protore resembled typical weathering processes.

Here we present the first results of a comprehensive carbon and oxygen isotope study in order to better characterize/understand the deep oxidation occurring at Skorpion, compared with the more limited weathering active in the Rosh Pinah area. A batch of 16 smithsonites and 5 (co-genetic) calcites from the Skorpion deposit and 10 gossanous samples (comprising host dolomite and smithsonite) from the uppermost levels of the Rosh Pinah mine have been analyzed.

The Zn- and Ca-carbonates sampled at Skorpion occur mostly as cavity fillings and crusts consisting of mm-sized euhedral crystals. Skorpion smithsonite is characterized by $\delta^{13}\text{C}$ values strongly variable between 0.1 and -9.1‰ VPDB, and by a small range in $\delta^{18}\text{O}$ (28.0 to 29.9‰ VSMOW). Calcite shows more limited variations: the $\delta^{13}\text{C}$ values are generally positive (0 to 1.6‰ VPDB). The $\delta^{18}\text{O}$ values are slightly lower than those of smithsonite (25.4 to 27.1‰ VSMOW). The analyses of the Rosh Pinah samples show that the host dolomite is characterized by $\delta^{18}\text{O}$ values ranging from 18.7 to 22.0‰ VSMOW and by negative $\delta^{13}\text{C}$ values. The carbon isotope ratios of smithsonite, as in Skorpion, are negative but similar to those of the host dolomites. The $\delta^{18}\text{O}$ values are on average the same measured at Skorpion.

The similar negative $\delta^{13}\text{C}$ values of smithsonite and dolomite from Rosh Pinah, point to the involvement of both organic and host dolomite carbon for smithsonite formation, whereas, at Skorpion, the involvement of isotopically light organic carbon is considered more probable. The

same $\delta^{18}\text{O}$ compositions of smithsonite from the two deposits imply similar ore-forming fluids and/or similar conditions during formation.

References:

- [1] Alchin DJ et al. (2005) S Afr J Geol 108: 19-3
- [2] Borg G et al. (2003) Econ Geol 98: 749-771
- [3] Alchin DJ and Moore JM (2005) S Afr J Geol 108: 71-86

